1) The ASCII is a code.
(a) 5 bit (b) 6 bit (c) 7 bit (d) 8 bit

2) The EBCDIC is a code.
(a) 5 bit (b) 6 bit (c) 7 bit (d) 8 bit

3) The collection of facts and figures is called
(a) Information (b) Statistics (c) Mathematics (d) Data

4) The data after processing is called
(a) Information (b) Processed (c) Percentage (d) Information

5) The set of characters including 26 characters of English alphabets and 10 decimal digits is called
(a) Numeric data (b) Alphabet data (c) Alphanumeric (d) All

6) Computers directly understand digits
(a) Decimal (b) Binary (c) Octal (d) Hexdecimal

7) Computer did not directly understand
(a) Letters (b) Decimal (c) Both a & b (d) None

8) 45, 26, 15, 40 is a
(a) Arranged data (b) Mechanical (c) Raw (d) Fixed

9) Data is classified into typed
(a) 2 (b) 3 (c) 4 (d) 5

10) Binary numbers are
(a) 1, 3 (b) 0, 10 (c) 0, 1 (d) 1, 1

11) Real data contains numbers, which may be
(a) Fractions (b) Whole Numbers (c) Both a & b (d) None

12) The base of decimal number system is
(a) 2 (b) 8 (c) 10 (d) 16

13) The data is represented on a computer by means of a two state ON and OFF system called
(a) A word (b) Binary system (c) Octal system (d) ROM

14) The base of binary number system is
(a) 2 (b) 8 (c) 10 (d) 16

15) The base of octal number system is
(a) 2 (b) 8 (c) 10 (d) 16

16) The binary number system is used in
(a) Analog computers (b) Binary computers
(c) Decimal computers (d) Digital computers

17) The base of hexadecimal number system is
(a) 2 (b) 8 (c) 10 (d) 16

18) Alphanumeric characters are expressed in terms of binary codes. In ASCII each character is represented as a
(a) 8 bit code (b) 4 bit code (c) 2 bit code (d) 7 bit code

19) 2's complement of 1011.1 is
(a) 0. 100.10 (b) 0100.1 (c) 1011.10 (d) 0100.01

20) 1's complement of 1011.1 is
(a) 0. 100.101 (b) 0100.11 (c) 1011.0 (d) 0100.0

21) A byte consist of nibbles
(a) 1 (b) 2 (c) 3 (d) 4

22) $10^0 =$ __________
(a) 10 (b) 0 (c) 1 (d) 101

23) The digit from 0 to 9 are called
(a) Decimal (b) Octal (c) Binary (d) Hexa

24) The binary equivalent of $(20)_{10}$ is
(a) 1111 (b) 10011 (c) 10010 (d) 10100

25) The decimal equivalent of $(20)_{10}$ is
(a) 18 (b) 24 (c) 20 (d) Invalid

26) Decimal number system consists of
(a) 0,1,2,3,4,5 (b) 0,1,2,3,4,5,6 (c) 0,1,2,3,4,5,6,7 (d) 0,1,2,3,4,5,6,7,8,9

27) 453 =
(a) $4 \times 10^2 + 5 \times 10 + 3$ (b) $10 \times 4^2 + 5 \times 10$
(c) $4 \times 10^2 + 5 \times 10^1 + 3 \times 10^0$ (d) None

28) The decimal equivalent of $(10)_8$ is
(a) 9 (b) 10 (c) 11 (d) 8

29) $(236)_{10} = (\ ?\ )_{10}$
(a) 158 (b) 157 (c) 155 (d) 236

30) $(A)_{16} = (\ ?\ )_{10}$
(a) 10 (b) 11 (c) 16 (d) 12

31) In 645 the most significant digit is
(a) 4 (b) 5 (c) 6 (d) 45

32) In 724 the least significant digit is
(a) 7 (b) 4 (c) 2 (d) 72

33) The number system that contains the range of 10 number and 6 alphabets is
(a) Decimal (b) Octal (c) Binary (d) Hexa

34) $(0001)_2 = (\ ?\ )_{16}$
(a) A (b) 10 (c) 1 (d) 7

35) Binary digits are denoted by
(a) IBT (b) TBI (c) BIT (d) BTI

36) $01001_{(2)}$ in decimal system is equal to
(a) 10 (b) 15 (c) 18 (d) 9

37) 1's complement of 01110 is
(a) 00011 (b) 10001 (c) 11001 (d) 01010

38) In binary number system 0 + 0 = ?
(a) 1 (b) 0 (c) 00 (d) 10

39) In binary number system 1 X 0 = ?
(a) 1 (b) 0 (c) 10 (d) 01

40) ASCII for 6 is equal to
(a) 0110001 (b) 0110110 (c) 1101100 (d) 0011010

41) Which of the following is not a real number?
(a) 76.2 (b) 6.2 (c) 4 (d) 4.0

42) In Hexadecimal number system the value of E is
(a) 15 (b) 12 (c) 14 (d) 16

43) The value of hexadecimal digit A is
(a) 9 (b) 10 (c) 11 (d) 12

44) The number 822 represent the
(a) Binary number (b) Octal Number (c) Decimal (d) None

45) Add 01011101 and 00110010
(a) 100111 (b) 1010101 (c) 10001111 (d) 100011111

46) The binary equivalent of decimal number $(3)_{10}$ is
(a) 10 (b) 11 (c) 111 (d) 101

47) The binary equivalent of $(F)_{16}$ is
(a) 1010 (b) 1110 (c) 0111 (d) 1111

48) The hexadecimal equivalent of binary number $(101001)_2$ is
(a) 2A (b) 2B (c) 29 (d) 28

49) The most commonly used character for transmission are
(a) EBCDIC (b) BCD (c) UNI (d) ASCII

50) In scientific notation power of 10 is called
(a) Logarithm (b) Exponent (c) Mantissa (d) Coefficient

ANSWER KEY

1	C	11	A	21	B	31	C	41	C
2	D	12	C	22	C	32	B	42	C
3	D	13	B	23	A	33	D	43	B
4	A	14	A	24	D	34	C	44	C
5	C	15	B	25	C	35	C	45	C
6	B	16	D	26	D	36	D	46	B
7	C	17	D	27	C	37	B	47	D
8	C	18	D	28	D	38	B	48	C
9	B	19	B	29	D	39	B	49	D
10	C	20	C	30	C	40	B	50	C

SHORT QUESTIONS

Q.1 Define Data.

DATA

The collection of raw facts and figure is called data e.g. live I Lahore.

Q.2 Define Information.

INFORMAION

The processed form of data is called information e.g. I live in Lahore.

Q.3 What is Number System?

NUMBER SYSTEM

Number system defines a set of values used to represent different quantities as the basics for counting, comparing amounts, making measurements, setting limits and transmitting data can be classified as number system.

Q.4 What is Decimal Number System?

DECIMAL NUMBER SYSTEM

The number system that we used in our day to day life is called the decimal number system. The decimal number system consists of 10 digits from 0 to 9 and any number can be represented by using these ten digits only. The decimal number system has base 10.

Q.5 What is Binary Number System?

BINARY NUMBER SYSTEM

The word binary means "two". The binary number system uses two digits 0 and 1 to represent any quantity. The binary number system has base 2. These digits are called binary digits.

Q.6 What is Octal Number System?

OCTAL NUMBER SYSTEM

The octal number system consists of 8 digits from 0 to 7. In this number system, the base is 8.

Q.7 What is Hexadecimal Number System?

HEXADECIMAL NUMBER SYSTEM

The Hexadecimal number system consists of 16 digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. The decimal values of A, B, C, D, E, and F are 10, 11, 12, 13,14, and 15 respectively. The base of this number system is 16.

Q.8 What is Binary Arithmetic?

BINARY ARITHMETIC

All the arithmetic operations are performed on the numeric values inside the digital computer in binary number system. The rules of binary arithmetic are same as for decimal number system. The binary addition, subtraction, multiplication and division are binary arithmetic operations.

Q.9 What is Binary Addition?

BINARY ADDITION

When two bits (or binary digits) are added and if sum is equal to or greater than 2 then it is divided by 2. Then remainder is written as answer and quotient is shifted as carry to next higher column. There are four rules for binary addition. These are

(i) 0 + 0 = 0
(ii) 0+1 = 1
(iii) 1+0=1
(iv) 1 + 1=0 Plus a carry of 1 of the next higher column. If no higher column exists then 1 + 1 = 10

Q.10 What is Binary Subtraction?

BINARY SUBTRACTION

The binary subtraction is carried out by complement method inside the computer. This method will be discussed in the next topic. The subtraction with direct method is given below. There are also four rules for binary subtraction (for direct I method). These are

(i) 0-0=0
(ii) 1-0=1
(iii) 1-1=0
(iv) 0-1 = 1 With a borrow (of 2) from the next higher column.

Q.11 What is Binary Multiplication?

BINARY MULTIPLICATION

There are also four rules for multiplication. These are

(i) 0x0=0
(ii) 0x1=0
(iii) 1x0 = 0
(iv) 1x1 = 1

Q.12 What is Binary Division?

BINARY DIVISION

The binary division is also performed in the usual way.

Q.13 What is 1's Complement?

1'S COMPLEMENT

1's complement of an 8-bit binary number is obtained by subtracting the number from $(11111111)_2$- For example, 1's complement of the binary number01100110 is taken as.

```
 1 1 1 1 1 1 1 1
 1 0 0 1 1 0 0 1
 ---------------
 0 1 1 0 0 1 1 0
```

Hence, 1' s complement of 10011001 is 01100110

It means that 1's complement of a binary number can be directly obtained by changing all 1's with O's and all O's with 1's.

Q.14 What is 2's Complement?

2'S COMPLEMENT

2's complement of a binary number can be obtained by first taking 1's complement and then adding 1 in the result. For example, to obtain the 2's complement of the binary number $(01\ 1001\ 10)_2$, following steps are performed.

1-Taking 1 ' s complement of the given binary number $(01100110)_2$ such as
10011001

2- Adding 1 to the result (i.e. 1's complement of 01100110) to obtain the 2's complement.

```
 10011001
        1
 --------
 10011010
```

Hence, 2's complement of $(01100110)_2$ is $(10011010)_2$.

Q.15 What is Fixed Point Representation?

FIXED POINT REPRESENTATION

The numbers that are represented by giving the decimal point at a fixed correct position between two appropriate digits is called fixed-point numbers.

Or

The numbers in which the position of a decimal point is needed to represent fractional part of a number. Such numbers are called as fixed-point number.

Q.16 What is meant coding?

CODING

The process of representation of numeric or non-numeric data in the form of machine code is called coding.

Q.17 What is BCD Code?

BCD CODE

BCD stands for Binary Coded Decimal. It is the earliest coding scheme. It is used to represent numeric data. In this coding scheme, each decimal digit ij represented by 4-bits.

Q.18 What is ASCII Coding Scheme?

ASCII CODE SCHEME

ASCII stands for American Standard Code for Information and Interchange.) is the standard code to represent alphanumeric data. This coding scheme was published by ISO (International Standards Organization).

Q.19 What is EBCDIC Coding Scheme?

EBCDC CODE SCHEME

EBCDIC stands for Extended Binary Coded Decimal Interchange Code, was introduced by IBM. It is an extended form of BCD code. It is 8-bit code and 256 characters can be represented in this coding scheme.

Q.20 What is Unicode?

UNICODE

UNICODE stands for Universal code. It is another popular coding scheme used these days. It is a 16-bit coding scheme and 65536 (2 = 65536 characters can be represented in this coding scheme.

Q.21 What is the difference between data and information?

DIFFERENCE BETWEEN DATA AND INFORMATION

DATA	INFORMATION
1. Collection of raw facts and figure is called data	1. Processed form of data is called information.
2. Data does not give useful and proper meanings.	2. Information gives useful and proper meanings.
3. Data does not depend upon information.	3. Information depends upon data.

LONG QUESTIONS

Q.1 What is a number System?

NUMBER SYSTEM

Number system defines a set of values used to represent different quantities. For example, we can represent the number of students in a class. The total number of digits in any number system is called its base.

The most commonly used number systems are

- Decimal number system.
- Binary number system.
- Octal number system.
- Hexadecimal number system.

In a digital computer system all kinds of data is represented as binary numbers. We use the decimal number system to represent quantities while the computer uses binary number system. Octal and hexadecimal numbers are also used commonly in computer system.

Q..2 Describe the importance of binary number system.

BINARY NUMBER SYSTEM

The word binary means "two". The binary number system uses two digits 0 and 1 to represent any quantity. The binary number system has base 2. These digits are called binary digits. The binary digit is abbreviated to Bit. The word Bit represents either of the binary digit 0 or 1.

Like decimal number system, the binary number system is also a positional number system and each position has a weight that is a power of 2. The positional value (or place value) of each digit in binary number is twice the positional value of the digit of its right e.g.

6th	5th	4th	3rd	2nd	1st	Position
$2^5 = 32$	$2^4=16$	$2^3=8$	$2^2=4$	$2^1 = 2$	$2^0=1$	Weight

3 What is meant by computer codes? Describe in detail.

COMPUTER CODES

The computers accept data and instructions in machine language (O's and 1's form). Therefore, the numeric and non-numeric data has to be converted into machine language or code.

The coding is defined as

The process of representation of numeric or non-numeric data in the form of machine code is called coding.

In coding process, each digit or character is represented by a group of bits. A group of 8-bits is called 1 byte. One character takes one byte in memory.

There are various codes to represent data. The commonly used computer codes are.

(1) BCD CODE.
(2) ASCII CODE.
(3) EBCDIC CODE.

BCD CODE

BCD stands for Binary Coded Decimal. It is the earliest coding scheme. It is used to represent numeric data. In this coding scheme, each decimal digit is represented by 4-bits. The BCD code table for 4-bit is given below.

Digit	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

ASCII Coding Scheme

ASCII is one such coding scheme published by ISO. It is a 7 bit coding scheme. It is a standard code to represent alphanumeric data.

Extended Binary Coded Decimal Interchange Code (EBCDIC)

IBM introduced a new way of character coding scheme called EBCDIC (Extended Binary Coded Decimal Interchange Code). It was a developed form of some of the existing codes like BCD. It is an 8-bil code so 256 different characters can be represented in EBCDIC. It was the most frequently used character code but with the increased use of the personal computer and computer networks the ASCII coding scheme became the standard coding scheme and now most of the computers use ASCII.

Unicode

Unicode is another popular coding scheme used these days. It is a 16-bit coding scheme so more than 216 = 65536 characters can be represented in this coding scheme.

Q.4 Explain the method for converting decimal to other system.

CONVERSION FROM DECIMAL TO OTHER SYSTEMS

A decimal number may consist of two parts, an integer and a fraction part. Different rules apply for converting the two parts of a decimal number to other number systems.

CONVERSION OF INTEGER PART

To convert the integer part of a decimal number, the remainder method is used. This method is as follows

1 Divide the integer part of the decimal number by the base B of other number system to which you want to convert the decimal number.
  In this step, you will get a quotient Q.1, and a remainder R1.
2 Divide again the Q.1 with base B. You Will get again a quotient Q.2 and a remainder R2.
3 Divide again the Q.2 by Base B to get quotient Q.3 and a remainder R3.

Repeat this process until the quotient becomes less than the Base B. Suppose the last quotient is q_n and remainder is R_n, where $q_{\cdot n}$ and R_n are the Last quotient and remainder respectively.

The required number or answer is written as

$$qn\ R_n\ R_n\text{-}1 \cdots R_3\ R_2\ R_1$$

CONVERSION OF DECIMAL FRACTION PART

The method to convert the fraction part of a decimal number into another number system is as follows

1 Multiply the fraction part of the decimal number with the base B of the other number system to which you want to convert the number.
  In this step you may get two parts an integer part I_1 and a fraction part F_1.
2 Multiply again the fraction part F_1 with the base B. You will again get an integer part I_2 and a fraction part F_2.
3 Repeat this process until the fraction part vanishes. The process wend the fraction part may be unlimited. You may have to do minimum 5 steps
4 The required number or answer is written as
  $I_1\ I_2\ I_3 \ldots\ldots\ldots\ldots\ldots\ I_n$
  where I_n is the integer part of the last step.

Q.4 How do you represent signed numbers in binary number system? Also explain the 1's complement method & 2's complement method.

Representing Signed Numbers

There are many methods to represent signed numbers (both +ve & -ve) binary number system. The most popular methods are sign-magnitude method, 1 complement method, 2's complement method and Access Notation. The most important and useful methods are 1 's complement method & 2's complement method.

1'S COMPLEMENT

1's complement of an 8-bit binary number is obtained by subtracting! number from $(11111111)_2$. For example, 1's complement of the binary number 01100110 is taken as.

11111111
10011001
01100110

Hence, 1' s complement of 10011001 is 01100110

It means that 1's complement of a binary number can be directly obtained changing all 1's with 0's and all 0's with 1's.

Example Take 1 's complement of the binary number 10011110.

Original number 10011110
1's complement 01100001

Representation of Negative Numbers Using 1's Complement

The following steps are performed to represent a negative number in complement form.

- First determine the number of bits to represent number.
- Convert the number into binary form.
- Place Os to left of binary number if required.
- Place 0 in MSB (Most Significant Bit) of the binary number.

Example Represent $(-54)_{10}$ in 1's complement form using 8-bit.

Number of bits = 8

$(54)_{10}$ $=(0110110)_2$

$(54)_{10}$ in 1's complement form = $(00110110)_2$

It is the final result because 1's complement representation of negative integer is same as the normal binary number representation and will always have a '0' in MSB.

2'S COMPLEMENT

Most computers use 16 bits to represent integers. The 2's complement method is very useful for representing signed number. Most computers represent integers using this method. Similarly, many digital calculators also use this method for representing integers. 2's complement of a binary number can be obtained by first taking 1's complement and then adding 1 in the result. For example, to obtain the 2's complement of the binary number $(01100110)_2$, following steps are performed.

1 -Taking 1's complement of the given binary number $(01100110)_2$ such as

10011001

2- Adding 1 to the result (i.e.1's complement of 01100110) to obtain the 2's complement.

10011001
1
10011010

Hence, 2's complement of $(01100110)_2$ is $(10011010)_2$.

We can obtain 2's complement of a binary number directly without taking 1's complement. The following steps are performed to obtain the 2's complement directly.

- Copy binary number from right side without any change up to the first 1 (least significant).
- Change remaining 0s to 1s and 1s to 0s.

For example to obtain the 2's complement of binary number $(1100110)_2$

Original number 01100110

2's complement 10011010

Representation of Negative Numbers Using 2's Complement

The following steps are performed to represent a negative number in 2's complement form.

- First determine the number of bits to represent number.
- Convert the number into binary form.
- Place Os to left of binary number.
- Place 0 in MSB (Most Significant Bit) of the binary number.
- Take 2's complement of the result.

Example Represent $(-54)_{10}$ in 2's complement form using 8-bit.

Number of bits = 8

$(54)_{10}$ $=(0110110)_2$

Place 0 in MSB of the binary number $=(00110110)_2$

$(-54)_{10}$ in 2's complement form $=(11001010)_2$

It is noted that-2's complement of a negative integer will always have a 1 in the most significant bit (MSB).

Q.5 How numbers are subtracted using 1's complement? Explain with examples.

Subtraction Using 1's Complement

1's complement method is very easy and shortcut method for subtract binary numbers. You can subtract smaller number from larger number. Similarly, you can also subtract larger number from smaller number.

Subtracting Smaller Number From Larger Number.

The following steps are taken to subtract smaller number from larger number.

1. Convert the numbers into binary form using 8-bits.
2. Find 1's complement of smaller binary number.
3. Add the result of step-(2) to the larger number. Do not include the last carry bit.
4. Add last carry bit to the result of step-(3).
5. Convert the 1's complement result directly into decimal.

Q.6 How numbers are subtracted using 2's complement? Explain with examples.

Subtraction Using 2's Complement

2's complement method is also very easy and shortcut method for subtracting binary numbers. You can subtract smaller number from larger number. Similarly, you can also subtract larger number from smaller number.

Subtracting Smaller Number from Larger Number.

The following steps are taken to subtract smaller number from larger number.

1. Convert the numbers into binary form using 8-bits.
2. Find 2's complement of smaller binary number.
3. Add the result of step-(2) to the larger number. Do not include the last carry bit. It is the final result in binary form.
4. Convert the 2's complement result directly into decimal.

Q.7 Describe the fixed point number representation.

Fixed Point Representation

The numbers that are represented by giving the decimal point at a fixed correct position between two appropriate digits is called fixed-point numbers.

Or

The numbers in which the position of a decimal point is needed to represent factional part of a number. Such numbers are called as fixed-point number.

The examples of fixed-point numbers are 2.7, 22.58, 0.183 etc.

A table is given below to explain the concept of fixed point representation.

Number	Number written by using the rule	Number without decimal point
73.4	0073.400	0073400
120.3446	0120.344	0120344
110	0110.000	0110000

In the above table, the second column in side the computer, real numbers are also represented in a similar way.

The following rules are followed to represent the real numbers inside the computer.

(i) Number may be represented using 8-bits, 16-bit, 32-bits or more.
(ii) Decimal point will not be written.
(iii) MSB is used to represent sign of the number. 0 is used for +ve and 1 is used for -ve number.
(iv) In case of 16 bit fixed point, 9 bits are used to store the integral part of the number and remaining 6 bits are used to represent the fractional part of the number. This format is shown below.

	Integral part	Fractional part

It must be noted that the advantage of fixed point representation is very simple to use. The disadvantage of fixed point representation is that very small or very large numbers cannot be represented using
this method.

Example

Represent 23.6 in 16 bit fixed point form using 10 bits for integral part.

1. Convert given decimal number into binary form.

$(23)_{10}=(010111)_2$

$(0.6)_{10}=(.1001001)_2$

$(23.6)_{10}=(010111.1001001)_2$

2. Write binary number using 10 bits for integral part and 6 bits for fractional part.

$(23.6)_{10}=(010111.1001001)_2$

3. Write binary number in fixed point

$$(23.6)_{10}=(0000010111100100)_2$$

Q.8 Describe the floating-point representation with examples.

Floating Point Representation

Floating point representation is another way to represent real numbers. In this format, very small and very large numbers can be represented efficiently.

For example, a real number 0.000162 can be written as 0.162 x 10~3. This representation is known as the scientific notation. In this notation

(i) 10 is the Base

(ii) The power of 10 is called the Exponent

(iii The number is called Mantissa

In the above example, base is 10, power of base is -3 and number is 0.162. Therefore, the general format to write floating point number is

M x BE Where

"M" Represents the mantissa (or magnitude)

"B" Represents the base of number system.

"E" Represents the exponent.

We can also write binary number in a similar way. For example, the binary number 1000.1101 can be written as 0.1001101 x 104.

Most of the digital computers use floating-point format to represent real numbers. In computer memory only the mantissa and exponents are stored. Mostly the computers use 16-bits for representing floating-point numbers. The MSB is used for signed bit, which is represented by S. The bit '!' represents a negative number while bit '0' represents a +ve number. So the floating number is represented as;

(i) 6-bits are used to represent exponent.

(ii) 9-bits are used to represent mantissa.

The first bit of the mantissa is always 1, so in most modern computers it is not written. The representation of floating point-is shown below.

S	6-bit exponent	9-bit mantissa

Example Represent 17.5 as a 16-bit floating point number.

1. Convert the decimal number into binary form.

$(17)_{10} = (010001)_2$

$(.5)_{10} = (.10)_2$

So $(17.5)_{10} = (010001.10)_2$

2. Write the binary number into scientific notation

$(010001.10)_2 = 1.00110 \text{ X } 10^4$

3. Represent the number into floating point format.

Sign bit is = 0

Exponent = 4 and it is in 6 bit 2's complement form

= 000100

Mantissa = 1.00110 = 1.001100000

So the number in floating point format is

S	6-bit exponent	9-bit mantissa
0	0 0 0 1 0 0	0 0 1 0 0 0 0 0 0 0

The first bit of mantissa and the decimal point is not written

EXERCISE

1. Explain the following
- **a. Binary Number System**
- **b. Octal Number System**
- **c. Decimal Number System**
- **d. Hexadecimal Number System**
- **e. ASCII codes**
- **f. BCD**

BINARY NUMBER SYSTEM

The word binary means "two". The binary number system uses two digits 0's and 1's to represent any quantity. The binary number system has base 2. These digits are called binary digits. The binary digit is abbreviated to Bit. The word Bit represents either of the binary digit 0 or 1. Like decimal number system, the binary number system is also a positional number system and each position has a weight that is a power of 2. The positional value (or place value) of each digit in binary number is twice the positional value of the digit of its right.

Table demonstrating the position and weights of digits for the number 101

2	1	0	Position
1	0	1	Face Value
22	21	20	Weight

OCTAL NUMBER SYSTEM

The octal number system consists of 8 digits from 0 to 7. In this number system the base is 8. The digits are 0,1,2,3,4,5,6,7. In this system 271 is a valid number, while 768 is not a valid number because 8 is not a member of this number system. The positional value of each digit in octal number is given below

Table demonstrating the position and weights of digits for the number 542

2	1	0	Position
5	4	2	Face Value
8^2	8^1	8^0	Weight

DECIMAL NUMBER SYSTEM

The decimal number system consists of 10 digits from 0.1.2.3.4.5.6.7.8.9. The base of this number system is 10 the value of each digit of decimal number depends upon the following.

- The position of the digit in the number.
- The face value of digit i.e. the digit itself.
- The weight of digit with respect to position.

For example consider the decimal number 728. The position and weight of each digit is given below

3rd	2nd	1st	Position
7	2	8	Face Value
102	101	100	Weight

HEXA DECIMAL NUMBER SYSTEM

The Hexadecimal number system consists of 16 digits from 0.1.2.3.4.5.6.7.8.9,A,B,C,D,E,F. The decimal values A,B,C,D,E and F are10,11,12,13,14 and 15 respectively. The base of this number system is 16. The positional value of each digit in Hexadecimal number is given below.

Table demonstrating the position and weights of digits for the number F16

2	1	0	Position
F	1	6	Face Value
16^2	16^1	16^0	Weight

ASCII Coding Scheme

ASCII stands for American Standard Code for Information and Interchange. It is the standard code to represent alphanumeric data. This coding scheme was published by ISO (International Standards Organization). It is a 7-bit coding scheme. The ASCII codes assigned to various characters. An extension of ASCII code uses 8 bits called as ASCII-8 bits codes with an extra bit as a parity bit to make the total number of 1's either odd or even.

BCD CODE

BCD stands for Binary Coded Decimal. It is the earliest coding scheme. It is used to represent numeric data. In this coding scheme, each decimal digit is represented by 4-bits. The BCD code table for 4-bit is given below.

Table 4-bit BCD

Digit	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

2. **Explain the following using example**
   a. Data
   b. Information

DATA

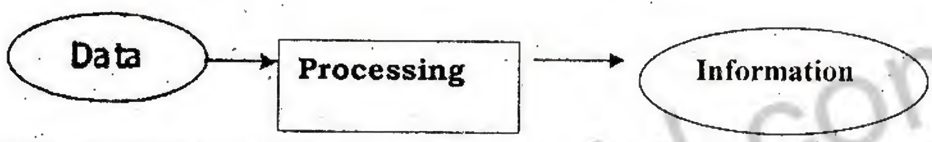
Data is defined as the collection of raw facts and figures that does not give proper meaning is called data. For example, if there are 4 students in a class who have appeared in an examination. The names and marks obtained of students are shown below.

Saleem	62	63	64
Babar	50	75	70
Amanat	90	80	70
Salma	75	80	60

The above list of names and numbers represent data of students. This data is in raw form and it does not clear the proper meaning.

INFORMATION

The raw data is processed to get the required result. The processed and refined data is referred to as information. Data processing may involve certain steps such as applying certain calculations, sorting and formatting etc. A system is shown below which shows the data processing steps.



The data processing can be done manually or by using computer. A computer is just a data processing machine. It accepts data as input, processes it and returns the processed data (i.e. information).

For example, the above data of 4 students is processed to get the information as

Sr. No	Name	English	Chemistry	Computer	Total	Grade
1	Saleem	62	63	64	189	B
2	Babar	50	75	70	195	B
3	Amanat	90	80	70	240	A+
4	Salma	75	80	60	215	A

3. What are the main types of data used in different computer applications? Explain the uses of each of the data types and the operations performed on it.

TYPES OF DATA

All computer programs use three basic types of data.

1. Numeric Data.
2. Alphabetic Data.
3. Alphanumeric Data.

Numeric Data

Numeric data is used to represent different quantities on which arithmetic is to be performed e.g. marks of different students, sales records of goods at a shop etc. Mostly this data is represented as integers or real numbers e.g. 45, 929, -85.09 etc. There are two types of numeric data.

1. Integer
2. Real Number

INTEGER DATA

Integer data consists of positive and or negative whole numbers including zero. For example +40,-59 etc. Real Number

REAL DATA

Real data contains numbers which may be fractions or incremental including integer numbers. For examples 4.5, 78.34 and etc.

Alphabetic Data

Alphabet data only consists of a fixed set of alphabetic characters e.g. data consisting of English alphabets A, B, C. ...Z as well as a, b, c....z. We can use these English alphabets to represent names of students in a class. This data is represented as a sequence of characters and no arithmetic operations can be carried out on it.

Alphanumeric Data

Alphanumeric data contains alphabets, numbers and other special characters i.e. $, #, % etc. Example of such data can be telephone numbers and addresses such as, 042-5758912 and House # 128, Street 4m XYZ Colony, Lahore etc.

4. Explain the 1's complement method of representing signed numbers. How can you perform subtraction using this method.

1'S COMPLEMENT

1's complement of an 8-bit binary number is obtained by subtracting the number from $(11111111)_2$. For example, 1's complement of the binary number 01100110 is taken as.

$$\begin{array}{r} 11111111 \\ 10011001 \\ \hline 01100110 \end{array}$$

Hence, 1' s complement of 10011001 is 01100110

It means that 1's complement of a binary number can be directly obtained changing all 1's with 0's and all 0's with 1's.

Example Take 1 's complement of the binary number 10011110.

Original number	10011110
1's complement	01100001

Representation of Negative Numbers Using 1's Complement

The following steps are performed to represent a negative number in complement form.

- First determine the number of bits to represent number.
- Convert the number into binary form.
- Place Os to left of binary number if required.
- Place 0 in MSB (Most Significant Bit) of the binary number.

Example Represent $(-54)_{10}$ in 1's complement form using 8-bit.

Number of bits = 8

$(54)_{10}$ $=(0110110)_2$

$(54)_{10}$ in 1's complement form = $(00110110)_2$

It is the final result because 1's complement representation of negative integer is same as the normal binary number representation and will always have a '0' in MSB

5. Explain the 2's complement method of representing signed numbers. How can you perform subtraction using this method?

2'S COMPLEMENT

Most computers use 16 bits to represent integers. The 2's complement method is very useful for representing signed number. Most computers represent integers using this method. Similarly, many digital calculators also use this method for representing integers. 2's complement of a binary number can be obtained by first taking 1's complement and then adding 1 in the result. For example, to obtain the 2's complement of the binary number (01100110)2, following steps are performed.

1 - Taking 1's complement of the given binary number $(01100110)_2$ such as

```
 11111111
 01100110
 ________
 10011001
```

2- Adding 1 to the result (i.e.1's complement of 01100110) to obtain the 2's complement.

```
 10011001
        1
 ________
 10011010
```

Hence, 2's complement of $(01100110)_2$ is $(10011010)_2$.

We can obtain 2's complement of a binary number directly without taking 1's complement. The following steps are performed to obtain the 2's complement directly.

- Copy binary number from right side without any change up to the first 1 (least significant).
- Change remaining 0s to 1s and 1s to 0s.

For example to obtain the 2's complement of binary number $(1100110)_2$

Original number 01100110

2's complement 10011010

For example to obtain the 2's complement of binary number $(1100110)_2$

Original number 01100110

2's complement 10011010

Representation of Negative Numbers Using 2's Complement

The following steps are performed to represent a negative number in 2's complement form.

- First determine the number of bits to represent number.
- Convert the number into binary form.
- Place 0's to left of binary number.
- Place 0 in MSB (Most Significant Bit) of the binary number.
- Take 2's complement of the result.

Example Represent $(-54)_{10}$ in 2's complement form using 8-bit.

Number of bits = 8

(54)10 = $(0110110)_2$ Place 0 in MSB of the binary number =$(00110110)_2$

$(-54)_{10}$ in 2's complement form = $(11001010)_2$

It is noted that-2's complement of a negative integer will always have a 1 in the most significant bit (MSB).

6. **Convert the following decimal numbers into binary, Octal and hexadecimal number system.**

(a) 78 (b) 97 (c) 129

(a)

Conversion of 78_{10} into binary number system

2	78
2	39-0
2	19-1
2	9-1
2	4-1
2	2-0
2	1-0

Hence $(78)_{10} = (1001110)_2$

Conversion of 78_{10} into octal number system

Sol.

8	78
8	9-6
	1-1

Hence $(78)_{10} = (116)_8$

Conversion of 78_{10} into Hexadecimal number system

16	78
	4-14-E

Hence $(78)_{10} = (4E)_{16}$

(b)

Conversion of 97_{10} into binary number system

2	97
2	48 – 1
2	24 - 0
2	12 - 0
2	6 – 0
2	3 – 1
2	1 -1

Hence $(97)_{10} = (1110001)_2$

Conversion of 97_{10} into octal number system

8	97
8	12-1
	1-4

Hence $(97)_{10} = (141)_8$

Conversion of 97_{10} into Hexadecimal number system

16	97
	6-1

Hence $(97)_{10} = (61)_{16}$

(c)

Conversion of 129_{10} into binary number system

2	129
2	64 - 1
2	32 - 0
2	16 - 0
2	8 - 0
2	4 - 0
2	2 - 0
2	1 - 0

Hence $(129)_{10} = (10000001)_2$

Conversion of 129_{10} into octal number system

8	129
8	16-1
8	2-0

Hence $(129)_{10} = (201)_8$

Conversion of 129_{10} into Hexadecimal number system

16	129
	8-1

Hence $(129)_{10} = (81)_{16}$

7. **Convert the following hexadecimal numbers into binary, octal and decimal number system.**

(a) 7A (b) IC2 (c) 89

(a)

Conversion of $(7A)_{16}$ into binary number system

$7 = 0111$

2	7
2	3-1
2	1-1

$A = 1110$

2	10
2	5-0
2	2-1
2	1-1

Hence $(7A)_{16} = (0111\ 1110)_2$

Conversion of $(7A)_{16}$ into octal number system

To convert $(7A)_{16}$ to octal, convert this number into decimal and then the result into octal number such as $(7A)_{16}$ =(?),,, =$(?)_8$

$$= 7\text{x } 16^1 + A\text{x } 16^0$$
$$= 7\text{x } 16 + 10 \text{ x } 1$$
$$= 7\text{x } 16 + 10 \text{ x } 1$$
$$= 122$$

Hence $(7A)_{16} = (122)_{10}$

Now convert $(122)_{10}$ into octal number such as $(122)_{10} = (?)_8$

8	122
8	15 – 2
	1 – 7

Hence $(7A)_{16} = (122)_{10} = (172)_8$

So $(7A)_{16} = (172)_8$

Conversion of $(7A)_{16}$ into decimal number system

$$(7A)_{16} = 7 \times 16^1 + A \times 16^0$$
$$= 7 \times 16 + 10 \times 1$$
$$= 112 + 10$$
$$= 122$$

Hence $(7A)_{16} = (122)_{10}$

Conversion of $(1C2)_{16}$ into binary number system

$1 = 0001$

$C = 1100$

2	12
2	6-0
2	3-0
2	1- 1

2 = 0010

2	2
2	1-0

Hence $(1C2)_{16}$= $(0001\ 1100\ 0010)_2$

Conversion of $(1C2)_{16}$ into octal number system

To convert $(1C2)_{16}$ to octal, convert this number into decimal and then the result into octal number such as $(1C2)_{16} =(?)_{10}=(?)_8$

$$= 1 \times 16^2 + C \times 16^1 + 2 \times 16^0$$
$$= 1 \times 256 + 12 \times 16 + 2 \times 1$$
$$= 256 + 192 + 2$$
$$= 450$$

Hence $(1C2)_{16} =(450)_{10}$

Now convert $(450)_{10}$ into octal number such as $(450)_{10}=(?)_8$

8	450
8	56-2
8	7 - 0

Hence $(1C2)_{16} =(450)_{10} = (702)_8$

So$(1C2)_{16}$= $(702)_8$

Conversion of $(1C2)_{16}$ into decimal number system

$$(1C2)_{16} = 1 \times 16^2 + C \times 16^1 + 2 \times 16^0$$
$$= 1 \times 256 + 12 \times 16 + 2 \times 1$$
$$= 256 + 192 +2$$
$$= 450$$

Hence $(1C2)_{16} =(450)_{10}$

(c)

Conversion of $(89)_{16}$ into binary number system

8 = 1000

2	8
2	4-0
2	2-0
2	1- 0

9 = 1001

2	9
2	4-1
2	2-0
2	1-0

Hence $(89)_{16}$= $(1000\ 1001)_2$

Conversion of $(89)_{16}$ into octal number system

To convert $(89)_{16}$ to octal, convert this number into decimal and then the result into octal number such as $(89)_{16}$=(?)10=$(?)_8$.

$$= 8 \times 16^1 + 9 \times 16^0$$
$$= 8\times 16 + 9 \times 1$$
$$= 128 + 9$$
$$= 137$$

Hence $(89)_{16}$ =$(137)_{10}$

Now convert $(137)_{10}$ into octal number such as $(137)_{10}$=$(?)_8$

8	137
8	17-1
8	2 - 1

Hence $(89)_{16}$ =$(450)_{10}$ = $(211)_8$

So$(89)_{16}$= $(211)_8$

Conversion of $(89)_{16}$ into decimal number system

$$(89)_{16} = 8 \times 16^1 + 9 \times 16^0$$
$$= 8\times 16 + 9 \times 1$$
$$= 128 + 9$$
$$= 137$$

Hence $(89)_{16}$ =$(137)_{10}$

8. Convert the following octal numbers into binary, decimal and hexadecimal number system.

(a) 125 (b) 57 (c) 777

(a)

Conversion of $(125)_8$ into binary number system

1= 011

2 = 010

2	2
2	1-0

5 = 101

2	5
2	2-1
2	1-0

Hence $(125)_8$= $(011\ 010\ 101)_2$

Conversion of $(125)_8$ into decimal number system

$$125 = 1 \times 8^2 + 2 \times 8^1 + 5 \times 8^0$$
$$= 1 \times 64 + 2 \times 8 + 5 \times 1$$
$$= 64 + 16 + 5$$
$$= 85$$

Hence $(125)_8 = (85)_{10}$

Conversion of $(125)_8$ into hexadecimal number system

To convert $(125)_8$ to hexadecimal, convert this number into decimal and then the result into hexadecimal number such as

$$125 = 1 \times 8^2 + 2 \times 8^1 + 5 \times 8^0$$
$$= 1 \times 64 + 2 \times 8 + 5 \times 1$$
$$= 64 + 16 + 5$$
$$= 85$$

Hence $(125)_8 = (85)_{10}$

Now convert $(85)_{10}$ into Hexadecimal number such as

$(85)_{10} = (?)_{16}$

16	85
16	5—5
	0—5

Hence $(125)_8 = (85)_{10} = (55)_{16}$

So $(125)_8 = (55)_{16}$

(b)

Conversion of $(57)_8$ into binary number system

5 = 101

2	5
2	2-1
2	1-0

7 = 111

2	7
2	3-1
	1-1

Hence $(57)_8 = (101\ 111)_2$

Conversion of $(57)_8$ into decimal number system

$$125 = 5 \times 8^1 + 7 \times 8^0$$
$$= 5 \times 8 + 7 \times 1$$
$$= 40 + 7$$
$$= 47$$

Hence $(57)_8 = (47)_{10}$

Conversion of $(57)_8$ into hexadecimal number system

To convert (125)8 to hexadecimal, convert this number into decimal and then the result into hexadecimal number such as

$57 = 5 \times 8^1 + 7 \times 8^0$
$= 5 \times 8 + 7 \times 1$
$= 40 + 7$
$= 47$

Hence $(57)_8 = (47)_{10}$

Now convert $(57)_{10}$ into Hexadecimal number such as

$(47)_{10} = (?)_{16}$

16	57
16	3—9

Hence $(57)_8 = (47)_{10} = (39)_{16}$

So $(57)_8 = (39)_{16}$

(c)

Conversion of $(777)_8$ into binary number system

7 = 111

2	5
2	2-1
2	1-0

7 = 111

2	7
2	3-1
2	1-1

7 = 111

2	7
2	3-1
2	1-1

Hence $(777)_8 = (111\ 111\ 111)_2$

Conversion of $(777)_8$ into decimal number system

$777 = 7 \times 8^2 + 7 \times 8^1 + 7 \times 8^0$
$= 7 \times 64 + 7 \times 8 + 7 \times 1$
$= 448 + 56 + 7$
$= 511$

Hence $(777)_8 = (511)_{10}$

Conversion of $(777)_8$ into hexadecimal number system

To convert $(125)_8$ to hexadecimal, convert this number into decimal and then the result into hexadecimal number such as

$777 = 7 \times 8^2 + 7 \times 8^1 + 7 \times 8^0$
$= 7 \times 64 + 7 \times 8 + 7 \times 1$
$= 448 + 56 + 7$
$= 511$

Hence $(777)_8 = (511)_{10}$

Now convert $(777)_{10}$ into Hexadecimal number such as

$(511)_{10}=(?)_{16}$

16	511
16	31—15-F
16	1-15-F

Hence $(777)_8 = (511)_{10} = (1FF)_{16}$

So $(777)_8 = (1FF)_{16}$

9. Convert the following binary numbers into octal, decimal and hexadecimal number system.

a. 01110101

b. 10101001

c. 00110011

(a)

Convert 01110101 into octal

First divide your number into groups of three bits starting from the right side so 01110101 is divided into the following three groups 001, 110, and 101

Convert each group into octal

$101 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 1 \times 4 + 0 \times 2 + 1 \times 1$
$= 4 + 0 + 1$
$= 5$

$110 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$
$= 1 \times 4 + 1 \times 2 + 0 \times 1$
$= 4 + 2 + 0$
$= 6$

$001 = 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 0 \times 4 + 0 \times 2 + 1 \times 1$
$= 0 + 0 + 1$
$= 1$

Hence $(01110101)_2 = (165)_8$

Convert 01110101 into decimal

$= 0 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 0 \times 128 + 1 \times 64 + 1 \times 32 + 1 \times 16 + 0 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1$
$= 64+32+16+4+1$
$= 117$

Hence $(01110101)_2 = (117)_{10}$

Convert 01110101 into hexadecimal

To convert $(01110101)_2$ to hexadecimal, convert this number into decimal and then the result into octal number such as

$01110101 = 0 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 1$
$= 0 \times 128 + 1 \times 64 + 1 \times 32 + 1 \times 16 + 0 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1$
$= 64+32+16+4+1$
$= 117$

Hence $(01110101)_2 = (117)_{10}$
Now convert $(117)_{10}$ into Hexadecimal number such as
$(117)_{10}=(?)_{16}$

16	117
16	7—5

Hence $(01110101)_2 = (117)_{10} = (75)_{16}$
So $(01110101)_2 = (75)_{16}$

(b)

Convert 10001001 into octal

First divide your number into groups of three bits starting from the right side so 10001001 is divided into the following three groups 010, 001, and 001

Convert each group into octal

$001 = 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 0 \times 4 + 0 \times 2 + 1 \times 1$
$= 0 + 0 + 1$
$= 1$

$001 = 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 0 \times 4 + 0 \times 2 + 1 \times 1$
$= 0 + 0 + 1$
$= 1$

$010 = 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$
$= 0 \times 4 + 1 \times 2 + 0 \times 1$
$= 0 + 2 + 0$
$= 2$

Hence $(10001001)_2 = (211)_8$

Convert 10001001 into decimal

$= 1 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 1 \times 128 + 0 \times 64 + 0 \times 32 + 0 \times 16 + 1 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1$
$= 128+0+0+0+8+0+0+1$
$= 136$

Hence $(10001001)_2 = (136)_{10}$

Convert 01110101 into hexadecimal

To convert (01110101)2 to hexadecimal, convert this number into decimal and then the result into octal number such as

$= 1 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$
$= 1 \times 128 + 0 \times 64 + 0 \times 32 + 0 \times 16 + 1 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1$
$= 128+0+0+0+8+0+0+1$
$= 136$

Hence $(01110101)_2 = (136)_{10}$
Now convert $(136)_{10}$ into Hexadecimal number such as
$(136)_{10}=(?)_{16}$

16	136
16	8—8

Hence $(01110101)_2 = 136)_{10} = (88)_{16}$
So $(01110101)_2 = (88)_{16}$

(c)

Convert 11111111 into octal

First divide your number into groups of three bits starting from the right side so 11111111 is divided into the following three groups 011, 111, and 111

Convert each group into octal

$111 = 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= 1 \times 4 + 1 \times 2 + 1 \times 1$
$= 4 + 2 + 1$
$= 7$

$111 = 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= 1 \times 4 + 1 \times 2 + 1 \times 1$
$= 4 + 2 + 1$
$= 7$

$011 = 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= 0 \times 4 + 1 \times 2 + 1 \times 1$
$= 0 + 2 + 1$
$= 3$

Hence $(10001001)_2 = (377)_8$

Convert 11111111 into decimal

$= 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= 1 \times 128 + 1 \times 64 + 1 \times 32 + 1 \times 16 + 1 \times 8 + 1 \times 4 + 1 \times 2 + 1 \times 1$
$= 128+64+32+16+8+4+2+1$
$= 255$

Hence $(11111111)_2 = (255)_{10}$

Convert 11111111 into hexadecimal

To convert (01110101)2 to hexadecimal, convert this number into decimal and then the result into octal number such as

$= 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
$= 1 \times 128 + 1 \times 64 + 1 \times 32 + 1 \times 16 + 1 \times 8 + 1 \times 4 + 1 \times 2 + 1 \times 1$
$= 128+64+32+16+8+4+2+1$
$= 255$

Now convert $(255)_{10}$ into Hexadecimal number such as

$(255)_{10} = (?)_{16}$

16	255
16	15—15-F

Hence $(11111111)_2 = (255)_{10} = (FF)_{16}$

So $(11111111)_2 = (FF)_{16}$.

10. Convert the following BCD numbers into Decimal

a. 00111001

b. 00000111

c. 10000001

(a)

Convert BCD code 00111001 into decimal

First divide your number into groups of four bits starting from the right side so 00111001 is divided into the following three groups 0011and 1001

Convert each group into Decimal

$1001 = 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 1 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1$

$= 8 + 0 + 0 + 1$

$= 9$

$0011 = 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 0 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1$

$= 0 + 0 + 2 + 1$

$= 3$

Hence $(00111001)_2 = (39)_{10}$

(b)

Convert BCD code 00000111 into decimal

First divide your number into groups of four bits starting from the right side so 00000111 is divided into the following three groups 0111and 0000

Convert each group into Decimal

$\mathbf{0111} = 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 0 \times 8 + 1 \times 4 + 1 \times 2 + 1 \times 1$

$= 0 + 4 + 2 + 1$

$= 7$

$0000 = 0$

Hence $(00000111)_2 = (07)_{10}$

(c) Convert BCD code 10000001 into decimal

First divide your number into groups of four bits starting from the right side so 10000001 is divided into the following three groups 0001and 1000

Convert each group into Decimal

$0001 = 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 0 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1$

$= 0 + 0 + 0 + 1$

$= 1$

$1000 = 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 1 \times 8 + 0 \times 4 + 0 \times 2 + 0 \times 1$

$= 8 + 0 + 0 + 0$

$= 8$

Hence $(10000001)_2 = (81)_{10}$

11. Represent the following 8-bits 1's complement and 10-bits 2's complement numbers.

a- 76 **b- -98** **c- -126**

(a) 1's Complement

Number of bits = 8

Number = 76

Convert 76 into binary

	76
	38-0
	19-0
	9-1
	4-1
	2-0
	1-0

$(76)_{10} = (01001100)_2$

So in 1's complement form 76

```
 11111111
 01001100
 --------
 10110011
```

Hence 1's complement of 76 is 10110011

2's Complement

Number of bits = 10

Number = 76

Convert 76 into binary

2	76
2	38-0
2	19-0
2	9-1
2	4-1
2	2-0
2	1-0

$(76)_{10} = (0001001100)_2$

So in 2's complement form 76

```
 1111111111
 0001001100
 ----------
 1110110011
          1
 ----------
 1110110100
```

Hence 2's complement of 76 is 1110110100

(b) 1's Complement

Number of bits = 8

Number = -98

Convert -98 into binary

	98
	49-0
	24-1
	12-0
	6-0
	3-0
	1-1

$(-98)_{10} = (01100010)_2$

So in 1's complement form -98

```
 11111111
 01100010
 --------
 10011101
```

Hence 1's complement of -98 is 10011101

2's Complement

Number of bits = 10

Number = -98

Convert -98 into binary

2	98
2	49-0
2	24-1
2	12-0
2	6-0
2	3-0
2	1-1

(-98)10 = (0001100010)2

So in 2's complement form -98

```
 1111111111
 0001100010
 ----------
 1110011101
          1
 ----------
 1110011110
```

Hence 2's complement of -98 is 1110011110

(c) 1's Complement

Number of bits = 8

Number = -126

Convert -126 into binary

2	126
2	63-0
2	31-1
2	15-1
2	7-1
2	3-1
2	1-1

$(-126)_{10} = (01111110)_2$

So in 1's complement form -126

11111111
01111110
10000001

Hence 1's complement of -126 is 10000001

2's Complement

Number of bits = 10

Number = -126

Convert -126 into binary

2	126
2	63-0
2	31-1
2	15-1
2	7-1
2	3-1
2	1-1

(-126)10 = (0001111110)2

So in 2's complement form -126

1111111111
0001111110
1110000001
1
1110000010

Hence 2's complement of -126 is 1110000010

12. Represent the following 8-bits 1's complement numbers into decimal.

a- 00101011 **b- 10001001** **c- 11111111**

(a)

i) The number is already in 1 's complement form, convert it into normal binary form by taking 1 's complement again as;

11111111
11010100
00101011

ii) Convert the number into decimal form as;

$= 1 X2^7 +1 X2^6 +OX2^5 +1 X2^4 +OX2^3 +1 X2^2 +Q.X2^1 +0X2^0$

= 128+64+0+16+0+4+0+0

= 212

Hence $(11010100)_2 = (212)_{10}$

(b)

ii) The number is already in 1 's complement form, convert it into normal binary form by taking 1 's complement again as;

11111111
10001001
01110110

ii) Convert the number into decimal form as;

$$= 0 X2^7 +1 X2^6 +1X2^5 +1 X2^4 +OX2^3 +1 X2^2 +1X2^1 +0X2^0$$

= 0+64+32+16+0+4+2+0

= 118

Hence $(10001001)_2 = (118)_{10}$

(c)

iii) The number is already in 1 's complement form, convert it into normal binary form by taking 1 's complement again as;

$$\begin{array}{r} 11111111 \\ \underline{11111111} \\ \underline{00000000} \end{array}$$

ii) Convert the number into decimal form as;

$$= 0 X2^7 +0 X2^6 +0X2^5 +0 X2^4 +OX2^3 +0 X2^2 +0X2^1 +0X2^0$$

= 0+0+0+0+0+0+0+0

= 0

Hence $(11111111)_2 = (0)_{10}$

13. Represent the following 8-bits 2's complement numbers into decimal.

a- 00111101 **b- 11111111** **c- 10101010**

(a)

iv) The number is already in 2 's complement form, convert it into normal binary form by taking 2 's complement again as;

$$\begin{array}{r} 11111111 \\ \underline{00111101} \\ \underline{11000010} \\ \underline{1} \\ \underline{11000011} \end{array}$$

ii) Convert the number into decimal form as;

$$= 1 X2^7 +1 X2^6 +0X2^5 +0 X2^4 +OX2^3 +0 X2^2 +1X2^1 +1X2^0$$

= 128+64+0+0+0+0+2+1

= 195

Hence $(00111101)_2 = (195)_{10}$

(b)

v) The number is already in 2 's complement form, convert it into normal binary form by taking 2 's complement again as;

$$\begin{array}{r} 11111111 \\ \underline{11111111} \\ \underline{00000000} \\ \underline{1} \\ \underline{00000001} \end{array}$$

ii) Convert the number into decimal form as;

$$= 0 X2^7 +0 X2^6 +0X2^5 +0 X2^4 +OX2^3 +0 X2^2 +0X2^1 +1X2^0$$

= 0+0+0+0+0+0+0+1

= 1

Hence $(11111111)_2 = (1)_{10}$

(c)

vi) The number is already in 2 's complement form, convert it into normal binary form by taking 2 's complement again as;

$$\begin{array}{r} 11111111 \\ 10101010 \\ \hline 01010101 \\ 1 \\ \hline 01010110 \\ \hline \end{array}$$

ii) Convert the number into decimal form as;

$= 0 X2^7 +1 X2^6 +0X2^5 +1 X2^4 +OX2^3 +1 X2^2 +1X2^1 +0X2^0$

$= 0+64+0+16+0+4+2+0$

$= 86$

Hence $(11111111)_2 = (86)_{10}$

14. Perform the following subtraction using8-bits 1's complement method. Verify your answer by converting it into decimal. All numbers are in decimal system.

a. 57-126

b. 120-76

c. -20-52

(a)

We can write

57 – 126 = 57 + (-126)

Step 1 Write the magnitude the numbers 57 and 126 in binary form using 8 bits

2	57
2	28-1
2	14-0
2	7-0
2	3-1
2	1-1

57 = 00111001

2	126
2	63-0
2	31-1
2	15-1
2	7-1
2	3-1
2	1-1

126 = 01111110

Step 2 Take 1's complement of the negative number

$$\begin{array}{r} 11111111 \\ 01111110 \\ \hline 10000001 \\ \hline \end{array}$$

-126 = 10000001

Step 3 Add 1's complement representation

00111001
10000001
End carry 0 10111010
Add end carry 0
10111010

Step 4 Take 1's complement of step 3 result

11111111
10111010
01000101

Step 5 Convert the result into decimal

$= 0 X2^7 +1 X2^6 +0X2^5 +0 X2^4 +OX2^3 +1 X2^2 +0X2^1 +1X2^0$
$= 0 x 128 + 1 x 64 + 0 x 32 +0 x 16 + 0 x 8 + 1 x 4 + 0 x 2 +1 x1$
$= 0+64+0+0+0+4+0+1$
$= - 69$

(b)

We can write
120 – 76 = 120 + (-76)

Step 1 Write the magnitude the numbers 120 and 76 in binary form using 8 bits

2	120
2	60-0
2	30-0
2	15-0
2	7-1
2	3-1
2	1-1

120 = 01111000

2	76
2	38-0
2	19-0
2	9-1
2	4-1
2	2-0
2	1-0

76 = 01001100

Step 2 Take 1's complement of the negative number

11111111
01001100
10110011

-76 = 10110011

Step 3 Add 1's complement representation

	01111000
	10110011
End carry 1	100101011
Add end carry	1
	00101100

Step 4 Convert the result into decimal

$= 0 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 0 \times 128 + 0 \times 64 + 1 \times 32 + 0 \times 16 + 1 \times 8 + 1 \times 4 + 0 \times 2 + 0 \times 1$

$= 0+0+32+0+8+4+0+0$

$= 44$

(c)

We can write

-20 – 52 = -20 + (-52)

Step 1 Write the magnitude the numbers 20 and 52 in binary form using 8 bits

2	20
2	10-0
2	5-0
2	2-1
2	1-0

20 = 00010100

2	52
2	26-0
2	13-0
2	6-1
2	3-0
2	1-1

52 = 00110100

Step 2 Take 1's complement of the negative number

11111111
00010100
11101011

-20= 11101011

11111111
00110100
11001011

-52= 11001011

Step 3 Add 1's complement representation

	11101011
	11001011
End carry 1	110110110
Add end carry	1
	10110111

Step 3 Add 2's complement representation

01111111
10000010

End 1 100000001

Step 4 Convert the result into decimal

$= 0 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 0 \times 128 + 0 \times 64 + 0 \times 32 + 0 \times 16 + 0 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1$

$= 0+0+0+0+0+0+0+1$

$= 1$

(b)

We can write

12 – 106 = 12 + (-106)

Step 1 Write the magnitude the numbers 12 and 106 in binary form using 8 bits

2	12
2	6-0
2	3-0
2	1-1

12 = 00001100

2	106
2	53-0
2	26-1
2	13-0
2	6-1
2	3-0
2	1-1

106 = 01101010

Step 2 Take 2's complement of the negative number

11111111
01101010
10010101
1
10010110

-106 = 10010110

Step 3 Add 2's complement representation

00001100
10010110

End 0 10100010

Step 4 Take 2's complement of step 3 result

11111111
10100010
01011101
1
01011110

Step 4 Take 1's complement of step 3 result

11111111
10110111
01001000

Step 5 Convert the result into decimal

$= 0 X2^7 +1 X2^6 +0X2^5 +0 X2^4 +1X2^3 +0 X2^2 +0X2^1 +0X2^0$
$= 0 x 128 + 1 x 64 + 0 x 32 +0 x 16 + 1 x 8 + 0 x 4 + 0 x 2 +0 x1$
$= 0+64+0+0+8+0+0+0$
$= - 72$

15. Perform the following subtraction using8-bits 2's complement method. Verify your answer by converting it into decimal. All numbers are in decimal system.

a. 127 - 126
b. 12 - 106
c. -12 - 25

(a)

We can write
127 – 126 = 127 + (-126)

Step 1 Write the magnitude the numbers 127 and 126 in binary form using 8 bits

2	127
2	63-1
2	31-1
2	15-1
2	7-1
2	3-1
2	1-1

127 = 01111111

2	126
2	63-0
2	31-1
2	15-1
2	7-1
2	3-1
2	1-1

126 = 01111110

Step 2 Take 2's complement of the negative number

11111111
01111110
10000001
1
10000010

-126 = 10000010

Step 5 Convert the result into decimal

$= 0 X2^7 +1 X2^6 +0X2^5 +1 X2^4 +1X2^3 +1 X2^2 +1X2^1 +0X2^0$

$= 0 \times 128 + 1 \times 64 + 0 \times 32 +1 \times 16 + 1 \times 8 + 1 \times 4 +1 \times 2 +0 \times 1$

$= 0+64+0+16+8+4+2+0$

$= -94$

(c)

We can write

$12 - 25 = -12 + (-25)$

Step 1 Write the magnitude the numbers 12 and 106 in binary form using 8 bits

2	12
2	6-0
2	3-0
2	1-1

12 = 00001100

2	25
2	12-1
2	6-0
2	3-0
2	1-1

25= 00011001

Step 2 Take 2's complement of the negative number

11111111
00001100
11110011
1
11110100

-12 = 11110100

11111111
00011001
11100110
1
11100111

-25 = 11100111

Step 3 Add 2's complement representation

11110100
11100111
End 1 $1110110\cancel{1}$

Step 4 Take 2's complement of step 3 result

11111111
11011011
00100100
1
00100101

Step 5 Convert the result into decimal

$= 0 X2^7 +0X2^6 +1X2^5 +0 X2^4 +0X2^3 +1 X2^2 +0X2^1 +1X2^0$

$= 0 x 128 + 0 x 64 + 1 x 32 +0 x 16 +0 x 8 + 1 x 4 +0 x 2 +1x 1$

$= 0+0+32+0+0+4+0+1$

$= -37$

16. Perform the following subtraction using8-bits 1's and 2's complement method. Verify your answer by converting it into decimal. Explain why the results are not correct if there is needed.

a. -57 - 96

b. 120 - 110

c. -60 - 68

Note Solve all these parts by following question no 14 and 15

17. Perform the following subtraction using10-bits 1's and 2's complement method. Verify your answer by converting it into decimal.

a. -57 - 96

b. 120 - 110

c. -60 - 68

1's complement

We can write

$- 57 - 96 = -57 + (-96)$

Step 1 Write the magnitude the numbers 57 and 96 in binary form using 8 bits

2	57
2	28-1
2	14-0
2	7-0
2	3-1
2	1-1

57 = 0000111001

2	96
2	48-0
2	24-0
2	12-0
2	6-0
2	3-0
2	1-1

96 = 0001100000

Step 2 Take 1's complement of the negative number

1111111111
0000111001
1111000110

-57 = 1111000110

1111111111
0001100000
1110011111

-96 = 1110011111

Step 3 Add 1's complement representation

1111000110
1110011111

End carry 1 — 11101100101
Add end carry — 1

1101100110

Step 4 Take 1's complement of step 3 result

1111111111
1101100110

0010011001

Step 5 Convert the result into decimal

$=0\ X2^9 + 0\ X2^8 + 1\ X2^7 + 0\ X2^6 + 0X2^5 + 1\ X2^4 + 1X2^3 + 0\ X2^2 + 0X2^1 + 1X2^0$

$=0x512+0\ x256+1\ x\ 128+0\ x\ 64+0\ x\ 32+1\ x\ 16+1\ x\ 8+0\ x\ 4+0\ x\ 2+1\ x1$

$= 0+0+128+0+0+16+8+0+0+1$

$= -153$

2's complement

We can write

- 57 – 96 = -57 + (-96)

Step 1 Write the magnitude the numbers 57 and 96 in binary form using 8 bits

2	57
2	28-1
2	14-0
2	7-0
2	3-1
2	1-1

57 = 0000111001

2	96
2	48-0
2	24-0
2	12-0
2	6-0
2	3-0
2	1-1

96 = 0001100000

Step 2 Take 2's complement of the negative number

1111111111
0000111001

1111000110
1

1111000111

-57 = 1111000111

1111111111
0001100000

1110011111
1

1110100000

-96 = 1110100000

Step 3 Add 2's complement representation

	1111000111
	1110100000
End 1	11101100111

Step 4 Take 2's complement of step 3 result

	1111111111
-	1101100111
	0010011000
	1
	0010011001

Step 5 Convert the result into decimal

$=0 \times 2^9 + 0 \times 2^8 + 1 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$=0 \times 512 + 0 \times 256 + 1 \times 128 + 0 \times 64 + 0 \times 32 + 1 \times 16 + 1 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1$

$= 0+0+128+0+0+16+8+0+0+1$

$= -153$

Q..18. What are the smallest and largest numbers that could be represented in 8 bits?

The smallest 8-bit number is a -ve number whose MSB is 1 while the largest 8-bit number is a +ve number whose MSB is "0'.

Q..19. What are the smallest and largest numbers that could be represented in 8 bits 1's complement form?

Largest number is 127, and smallest number is -127, that could be represented in 8 bit 1's complement from using an 8 bit 1's complement representation.

Q..20 What are the smallest and largest numbers that could be represented in 8 bit 2's complement form?

Largest number is 127, and smallest number is -127, that could be Represented in 8 bit 1's complement from using an 8 bit 2's complement representation.

Q..21 Represent the following numbers using fixed point representation. Use the following format for the conversion. Also verify your results by converting your results back into decimal.

a) 25.5

To convert this real number we independently convert the integral part (i.e. 25) and the fractional part (i.e. 0.5) into binary by using the process given below.

2	25
2	12-1
2	6-0
2	3-0
2	1-1

25(10) = 11001

	Result	Fractional Part	Integral Part
2 X 0.5	1.0	0	1

0.5 = $.1_{(2)}$

So 25.5 = 011001.1

25.5=0000011001.100000

And in fixed point form

25.5 =0000011001100000

Now convert fixed-point into decimal

Integral part= $0000011001_{(2)}$

Fractional Part = $.100000_{(2)}$

Now

$0000011001 = 0 \times 2^9 + 0 \times 2^8 + 0 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 25$

Also

$.100000 = 1 \times 2^{-1} + 0 \times 2^{-2} + 0 \times 2^{-3} + 0 \times 2^{-4} + 0 \times 2^{-5} + 1 \times 2^{-6}$

$= .5$

So

0000011001100000 = 25.5

(b) 233.9

To convert this real number we independently convert the integral part (i.e. 233) and the fractional part (i.e. 0.9) into binary by using the process given below.

2	233
2	116-1
2	58-0
2	29-0
2	14-1
2	7-0
2	3-1
2	1-1

$233_{(10)}$ = 11101001

	Result	Fractional Part	Integral Part
2 X 0.9	1.8	.8	1
2 X 0.8	1.6	.6	1
2 X 0.6	1.2	.2	1
2 X 0.2	0.4	.4	0
2 X 0.4	0.8	.8	0
2 X 0.8	1.6	.6	1

0.9 = .111001(2)

So 233.9 = 011101001.111001

= 0011101001.111001

And in fixed point form

233.9 = 0011101001111001

Now convert fixed-point into decimal

Integral part= $0011101001_{(2)}$

Fractional Part = $.111001_{(2)}$

Now

$0011101001 = 0 \times 2^9 + 0 \times 2^8 + 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 233$

Also

$.111001 = 1X2^{-1} + 1\ X2^{-2} + 1X2^{-3} + 0\ X2^{-4} + 0X2^{-5}\ + 1X2^{-6}$

$= .9$

So

$0011101001111001 = 233.9$

(c) 33.6

To convert this real number we independently convert the integral part (i.e. 33) and the fractional part (i.e. 0.6) into binary by using the process given below.

2	33
2	16-1
2	8-0
2	4-0
2	2-0
2	1-0

$33_{(10)} = 100001$

	Result	Fractional Part	Integral Part
2 X 0.6	1.2	.2	1
2 X 0.2	0.4	.4	0
2 X 0.4	0.8	.8	0
2 X 0.8	1.6	.6	1
2 X 0.6	1.2	.2	1
2 X 0.2	0.4	.4	0

$0.6 = .100110(\ 2\ )$

So $33.6 = 0100001.10110$

$= 0000100001.101100$

And in fixed point form

$33.6 = 0000100001101100$

Now convert fixed-point into decimal

Integral part $= 0000100001_{(2)}$

Fractional Part $= .101100_{(2)}$

Now

$0011101001 = 0\ X2^9 + 0\ X2^8 + 0\ X2^7 + 0\ X2^6 + 1X2^5 + 0\ X2^4 + 0X2^3 + 0\ X2^2 + 0X2^1\ + 1X2^0$

$= 33$

Also

$.111001 = 1X2^{-1} + 0\ X2^{-2} + 1X2^{-3} + 1X2^{-4} + 0X2^{-5}\ + 0X2^{-6}$

$= .9$

So

$0000100001101100 = 33.6$

Q.24. Represent the following numbers using fixed point representation. Use the format given in the previous question for the conversion. Explain if there is any trouble.

a. 1025.5

b. -1233.9

c. -2333.6

(a) 1025.5

To convert this real number we independently convert the integral part(i.e. 1025) and the fractional part (i.e. 0.5) into binary by using the process given below.

	Number	Remainder
2	1025	
2	512	1
2	256	0
2	128	0
2	64	0
2	32	0
2	16	0
2	8	0
2	4	0
2	2	0
2	1	0

1025 = 010000000001(2)

Solution is not possible, because it has 12-bits for integral part.

(b) -1233.9

To convert this real number we independently convert the integral part(i.e. 1233) and the fractional part (i.e. 0.9) into binary by using the process given below.

	Number	Remainder
2	1233	
2	616	1
2	308	0
2	154	0
2	77	0
2	38	1
2	19	0
2	9	1
2	4	1
2	2	0
2	1	0

(c) -2333.6

To convert this real number we independently convert the integral part(i.e. 2333) and the fractional part (i.e. 0.6) into binary by using the process given below.

	Number	Remainder
2	2333	
2	1166	1
2	583	0
2	291	1
2	145	1
2	72	1

2	36	0
2	18	0
2	9	0
2	4	1
2	2	0
2	1	0
	0	1

$2333 = 0100100011101_{(2)}$
Solution is not possible because it has 13-bits for integral part.

Q.22. Represent the following numbers using floating point representation. Use the floating point format given in the chapter.

a. 1025.5
b. -1233.9
c. -2333.6

Step 1 To convert this real number we independently convert the integral part (i.e. 1025) and the fractional part (i.e. 0.5) into binary by using the process given below.

2	1025	
2	512	1
2	256	0
2	128	0
2	64	0
2	32	0
2	16	0
2	8	0
2	4	0
2	2	0
2	1	0
	0	1

1025= 010000000001

	Result	Fractional Part	Integral Part
2x0.5'	1.0	0	1

$0.5 = 0.1_{(2)}$
1025.5 = 010000000001.1
-1.00000000011x2'

Step 2 Represent the number in floating point Format. Sign = + = 0
Exponent = 10 and in 6-bit 2's complement form 001010 Mantisa = 1.00000000011 = 1.000000000

s	6-bit exponent	9-bit Mantista
0	001010	000000000

(b) -1233.9

Step 1 To convert this real number we independently convert the integral part (i.e.1233) and the fractional part (i.e. 0.9) into binary by using the process given below.

	Number	Remainder
2	1233	
2	616	1
2	308	0
-2	154 -	0
2	77	0
2	38	1
2	19	0
2	9	1
2	4	1
2	2	0
2	1	0

1233 = 10011010001

	Result	Fractional Part	Integral Part
2x0.9	1.8	8	1
2x0.8	1.6	6	1
2x0.6	1.2	2	1
2x0.4	0.8	8	0

0.9 = $1110_{(2)}$

-1233.9 = -010011010001.1110

= - 1.0011010001111x2^{10}

Step 2 Represent the number in floating point format.

Sign = - = 1

Exponent = 10 and in 6-bit 2's complement form 001010 Mantisa = 1.0011010001111=1.001101000

s	6-bit exponent	9-bit Mantista
01	**001010**	**001101000**

(c) -2333.6

Step 1 To convert this real number we independently convert the integral part (i.e.2333) and the fractional part (i.e. 0.6) into binary by using the process given below.

	Number	Remainder
2	2333	
2	1166	1
2	583	0
2	291	1
2	145	1
2	72	1
2	36	0
2	18	0
2	9	0
2	4	1
2	2	0
2	1	0

2333 = 100100011101
0.6 = $1001_{(2)}$
-2333.6 = -0100100011101.1001
-1.0010001110111001x2

	Result	Fractional Part	Integral Part
2x0.6	1.2	2	1
2x0.2	0.4	4	0
2x0.4	0.8	8	0
2x0.8	1.6	8	1

Step 2 Represent the number in floating point format.
Sign = - = 1
Exponent = 11 and in 6-bit 2's complement form 001010
Mantisa= 1.0010001110111001=-1.001000111
So the number in floating point is

s	6-bit exponent	9-bit Mantista
1	001011	001000111

Q.24. Represent the following messages using the ASCII codes given in the table of ASCII codes. Also verify your coded message by converting it back into English. (Do not forget to convert the space character).

a. He is a good student
b. 2+2=4
c. I like Computer Science
d. Binary numbers are GREAT

(a) Message "He is a good student" into ASCII Code
Table of ASCII codes represent the message

Character	Code
H	72
e	101
	32
i	105
s	115
	32
a	97
	32
g	103
0	111
o	111
d	100
	32
s	115
t	116
u	117
d	100

e	101
n	110
t	116

Converted message into ASCII Codes is as follow 32 105 329732 103 111 111 10032 115 116 117 100 101 110 116 convert back the above ASCII codes, you will get the message in ENGLISH again "He is a good student"

(b) Message 2+2=4 ASCII Code

Table of ASCII cedes represent the message

2	50
+	43
2	50
=	61
4	52

•So the converted message into ASCII Codes is as follow

50 43 50 61 52

If you convert back the above ASCII codes, you will get the message in ENGLISH again. "2 + 2 = 4"

(c) Message "I like Computer Science" into ASCII Code

Table of ASCII codes represent the message

Character	Code
I	73
	32
l	108
i	105
k	107
e	101
	32
C	67
o	111
m	109
P	112
u	117
t	116
e	101
r	114
	32
S	83
c	99
i	105
e	101
n	110
c	99
e	101

So the converted message into ASCII Codes is as follow

73 32 108 105 107 101 32 67 111 109 112 117 116 101 114 32 83 99 105 101 110 99 101
If you convert back the above ASCII codes, you will get the message in ENGLISH again.
"I like Computer Science"

(d) Message "Binary numbers are GREAT" into ASCII Code

Table of ASCII codes represent the message

Character	Code
B	66
i	105
n	110
a	97
r	114
y	121
	32
n	110
u	117
m	109
b	98
e	101
r	114
s	115
	32
a	97
r	114
e	101
	32
G	71
R	82
E	69
A	65
T	84

So the converted message into ASCII Codes is as follow
66 105 11097 114 121 32 110 117 10998 101 114 1153297 114 101 3271 82 69 65 84
If you convert back the above ASCII codes, you will get the message in ENGLISH again.
"Binary numbers are GREAT"

Q.25 Fill in the blanks

i) Data
ii) Information
iii) Signed magnitude, 1's complement, 2's complement
iv) American Standard Code for Information Interchange
v) 1024 vi) 1024
vii) 1101 1101
viii) Binary numbers
ix)S16
x) 1's complement

Q.26 Match the following

Data	Raw facts to which no meaning is attached and is ready for processing meaning is
Processing	Processing means to manipulate, calculate, distribute or arrange.
Information	Processed Data
ASCII	American Standard Code for Information Interchange.
$16_{(16)}$	$22_{(10)}$
$12_{(16)}$	$22_{(8)}$

Q.27 Choose the correct answer.

a) iii b) iv c) i d) i e) ii
i) F ii) F iii) F iv) F v) T vi) T vii) T viii) T ix) F x) F